نيوم NEOM

ENGINEERING PROCEDURES

RISK MANAGEMENT PROCEDURE

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1. Purpose

The purpose of this Risk Management Procedure is to identify potential problems before they occur so that risk-handling activities may be planned and invoked as needed across the life of the project to mitigate adverse impacts on achieving objectives.

2. Scope

The “ISO 31000:2018 Risk Management – Guidelines” standard defines risk as “effect of uncertainty on objectives,” with a note that clarifies “An effect is a deviation from the expected. It can be positive, negative or both, and can address, create or result in opportunities and threats.” This double-sided concept of risk is reflected in a range of other professional risk standards and guidelines, stating clearly that risk includes both threats and opportunities, and risk management should address both in an integrated common approach. The goal of risk management is to optimize achievement of objectives by minimizing threats and maximizing opportunities.

Risk management is a continuous, forward-looking process that is an important part of business and technical management processes. Risk management should address issues that could endanger achievement of critical objectives. A continuous risk management approach is applied to effectively anticipate and mitigate the risks that have critical impact on the project.

Effective risk management includes early and aggressive risk identification through the collaboration and involvement of relevant stakeholders. Strong leadership across all relevant stakeholders is needed to establish an environment for the free and open disclosure and discussion of risk.

Although technical issues are a primary concern both early on and throughout all project phases, risk management must consider both internal and external sources for cost, schedule, and technical risk. Early and aggressive detection of risk is important because it is typically easier, less costly, and less disruptive to make changes and correct work efforts during the earlier, rather than the later, phases of the project.

As per the NEOM Plan of Work, this Risk Management Procedure is intended for implementation in the following 5 stages: Stage 1 (Strategic Definition), Stage 2 (Master Planning & Asset Brief), Stage 3 (Design & Tendering), Stage 4 (Construction, Handover & Close-out), and Stage 5 (Operation & Maintenance).

3. Definitions

Table 1: Table of definitions

Term	Definition
Activity	A task to be accomplished in a set period of time as part of working toward a larger project goal. An Activity can be assigned to a resource(s) and have an associated cost. Activities are ordered with logic links.
Activity Relationship	An ordered link between one activity and others noting that there are multiple link types and that activities can have more than one relationship.
Asset	Refers to the required physical buildings or infrastructure such as residential, business facilities, commercial & retail facilities, media center, recreation, entertainment & sports facilities, marinas, hospital, medical clinics, religious facilities, school, library, fire stations, roads/streets/bridges, infrastructure system, and utility networks. Also, it relates to components of buildings and structures that need to be tracked and managed.

Term	Definition
Baseline	The combination of scope, budget and schedule that define the goals and objectives for overall Project deliver/ which have been agreed with NEOM and the Program Management Consultant (PMC) and are placed under configuration control for changes.
Department	Different entities and divisions constituting NEOM organization, which may include the Project Department, Operations Department, Proponent/Sponsor, Urban Department, Environment Department, Loss Prevention & Fire Safety Department, etc.
Design Consultant	The professional firm named in the Consultancy Agreement, who is employed by NEOM to perform the Design Services, and legal successors to the Design Consultant and permitted assignees.
Estimate	Evaluation of expected quantities, time and man-hours, with allowances and provisions for expected unknowns.
KPI	A Key Performance Indicator is a type of performance measurement. KPIs evaluate the success of an organization or of a particular activity in which it engages.
Milestone	An event to mark specific points in time along a project timeline. These points may signal anchors such as a project start and end date, a need for external review or input and budget checks, among others. In many instances, milestones do not impact project duration. Instead, they focus on major progress points that must be reached to achieve success.
NEOM Representative	Appointed Project Management Consultant, Supervision Consultant, other Consultants or NEOM Departments.
PMO	Project Management office responsible to manage NEOM Projects and Programs.
Portfolio	The term used for a collection of programs and projects which are grouped to achieve strategic goals. NEOM will be built from a Portfolio of programs/projects.
Program	Program reflects a suite of inter-related project that realize over-arching benefits.
Project	Refers to the development and delivery of aa NEOM Asset or a group of NEOM Assets.
Project Charter	The Project Charter provides the high-level project description and requirements. It also contains the key stakeholders list, summary milestones and approved financial resources that may influence the resource management of the project.
Qualitative Risk Analysis	A project management technique concerned with discovering the probability of a risk event occurring and the impact the risk will have if it does occur. All risks have both probability and impact.
Quantitative Risk Analysis	A simulated mathematical statistical assessment of both probability and impact for all risks or a sub-set of risks
Resource	A resource is a necessary asset whose main role is to help carry out a certain task or project. A resource can be a person, a team, tools, machinery, building materials, funding/money and time. The lack of a resource will be a constraint on the completion of the project activity.
Resource Management	Resource management comprises the acquisition and deployment of the internal and external resources required to deliver the project, program or portfolio.

Term	Definition
Schedule	A representation of the plan for executing the project's activities including dates, durations, dependencies, resources, costs and other planning information, used to produce a project schedule.
Scheduling Software	Software that provides schedule component names, definitions, structural relationships, and formats that support the application of a scheduling method.
S-Curve	S-Curve is a graphical representation of the measured element in a cumulative format (X axis) versus time (Y axis)

Table 2: Table of abbreviations

Abbreviation	Description
CBS	Cost Breakdown Structure
EPS	Enterprise Project Structure
KPI	Key Performance Indicator
OBS	Organization Breakdown Structure
PMO	Project Management Office
QSRA	Quantitative Schedule Risk Assessment
QCRA	Quantitative Cost Risk Assessment
RBS	Risk Breakdown Structure

4. Related NEOM Documents

The requirements contained in the following documents apply to the extent specified in this Procedure.

Table 3: Table of related engineering procedures

Document Code	Document Name
NEOM-NEN-PRC-005	Design Stages Deliverables Procedure.

Table 4: Table of cost estimation manual and procedures

Document Code	Document Name
NEOM-NCE-MNL-001	Cost Estimation Policies and Guidelines
NEOM-NCE-PRC-001	Cost Estimating Procedure.
NEOM-NCE-PRC-002	Key Performance Indicator Procedure.

Table 5: Table of program, planning & control manual and procedures

Document Code	Document Name
NEOM-NEN-MNL-001	Program, Planning and Control Manual.

5. RISK MANAGEMENT

5.1. Risk Management Plan

Each Risk Management Plan has been developed to follow the OBS and EPS of NEOM described in the Program Management procedures. It sets out the approach to Risk Management within NEOM. It is then expected that the Project Managers/ Design Consultants/ Contractors develop their own Risk Management Plans that follow the structure and scope of this Risk Management Plan.

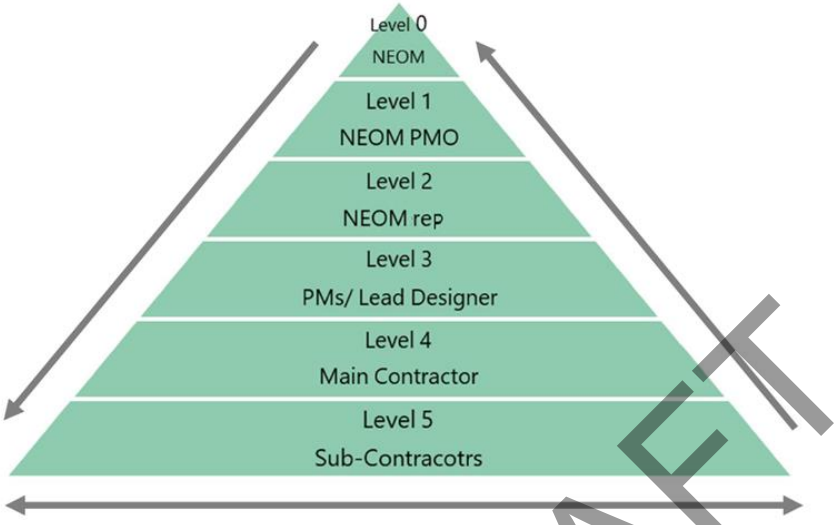


Figure 1: Risk management levels

Many different categories of Risks will be managed throughout NEOM at all levels, but it is important that the information flows vertically through the NEOM structure.

Figure 2 below shows the aggregation of Risk model within NEOM. Each Project in NEOM would have its own Risk Register, risks would be aggregated up to a Program level, and each risk would be scored (mentioned in later sections), so the Program level risk register could filter for the highest risks in terms of impact or probability. Risks could be identified and included at any level, Project, Program or Enterprise.

It is therefore important to standardize the Risk approach for NEOM in order to allow the flow of information / aggregation of risk through the hierarchical levels of NEOM.

Figure 2: Aggregation of risk model within NEOM

Figure 2 shows project level risks being managed at a lower level, and strategic risks being managed at a higher level. It is worth clarifying that strategic risks can be identified at any level, and also can be managed at any level, although it is more common for strategic or higher level risks to get escalated for management. The degree and level of Risk Management applied needs to be aligned to the specific phases of the program life cycles. In the hierarchy of the Enterprise, Program and Project environment there will be numerous risk registers. Contractors within projects can maintain their own risk registers. The PMO Risk Register would ultimately aggregate program Risk Registers from the NEOM Representative's Program Risk Registers. As each risk would ultimately be quantitatively and qualitatively scored so the PMO could identify the risks with the biggest impact/probability.

Risks can be identified at all levels, although the Program Risk Registers will aggregate project risks, risk can also be identified at Program level. The same applies at the PMO level Risk Register. Risks should be managed where possible at the level they are identified, i.e. Project, however in some cases certain risks need to be managed at a higher level (i.e. Project into Program). This will be considered an Escalation of risk, and it should be communicated as such.

This Risk Management Procedure has been developed using PMI® methodology. The PMI methodology has been developed using best practice, and PMI/Contractors will be familiar with the principles and be more comfortable adopting the Risk approach.

This Risk Management is very important and as such it is important to set up the framework correctly for which Risk Management will take place, namely:

- This Risk Management Procedure has been aligned to the relevant information in the NEOM Plan of Work.
- A Risk Register Template has been created and included as an Appendix to the Risk Management Plan.
- Primavera Risk Analysis software will be procured and used to carry out Monte Carlo Risk Analysis.

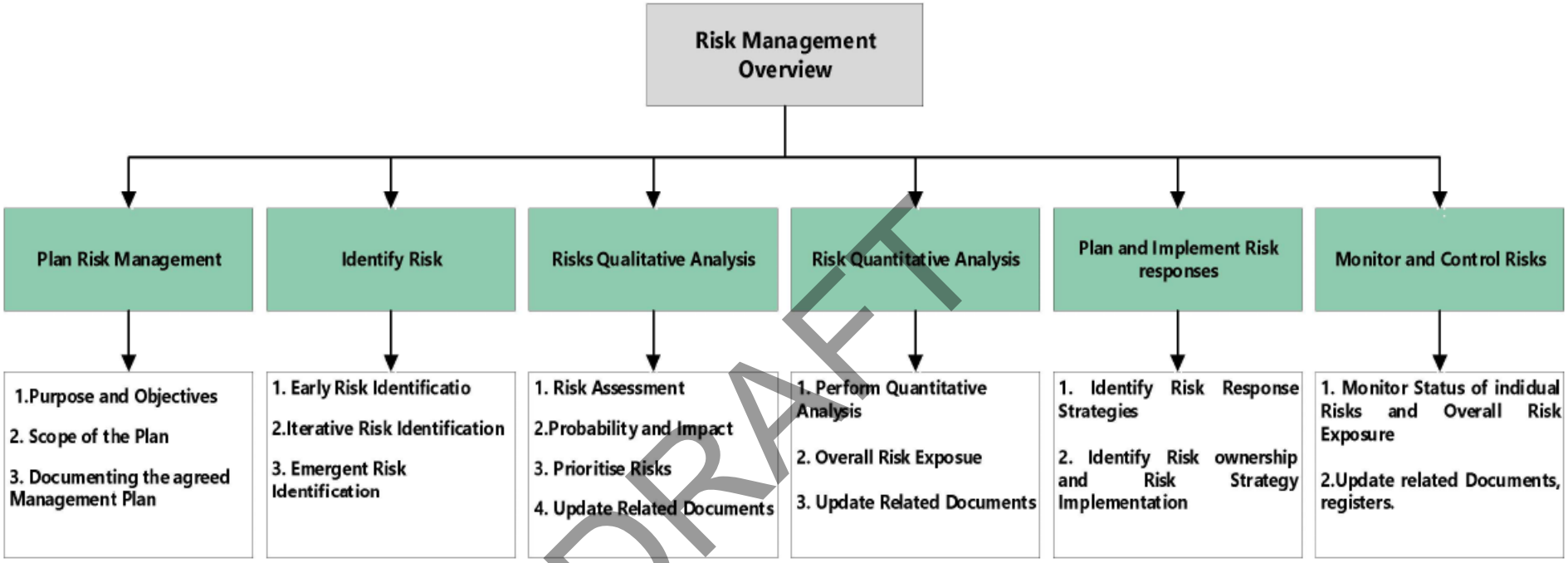


Figure 3: Risk management overview

NEOM Risk Process complies with ISO 31000:2018 process:

- Risk Identification and Capture – Using Risk Register.
- Qualitative Risk Analysis – Using Risk Register.
- Quantitative Risk Analysis – Using Risk Register and Primavera Risk Register.
- Risk Response Planning – Also captured in the Qualitative and Quantitative phases.
- Ongoing Risk Monitoring and Control.

The Risk Management Process for NEOM has many inputs:

Project Charter – This provides the outline Scope for the Program of works. As the Program develops, more scope documents will be produced for individual projects, and these will feed into the Risk Management process.

Management Plans – Schedule Management Plan feeds into the Risk Management Process. This document should be read in conjunction with this plan, and any change in the Process may lead to Project Document Update.

Organization Process assets – The Risk Management Plan has and will take into account all Organizational process assets.

Enterprise Environmental Factors are an important input to the Risk Management Process. By recognizing the uncertainty and building it into the risk process, identifying the risks associated with them, it allows more chance of program success. It is important to review/update the risk process/register any time there is an emergence of change in any of these areas.

5.2. Risk Identification

Risk identification is a deliberate and systematic effort to identify and document the program and the institution's key risks. The objective of risk identification is to understand what is at risk within the context of NEOM explicit and implicit objectives and to generate a comprehensive inventory of risks based on the threats and events that might prevent, degrade, delay or enhance the achievement of the objectives. This necessitated the importance of the risk identification process, which intents full and comprehensive identification of risks in all aspects of the program.

Comprehensive and thorough identification and recording of risks is critical and is seen as the cornerstone for the success of this risk management procedure. For this, there are three phases of risk identification procedure that should be implemented. The three phase risk identification procedure aims to maximize the value and effectiveness of the identify risks process and enhance the likelihood of identifying as many risks as practicable.

Risk identification shall comprise three steps:

- Identify Risks
- Collecting and Analyzing
- Documenting Results

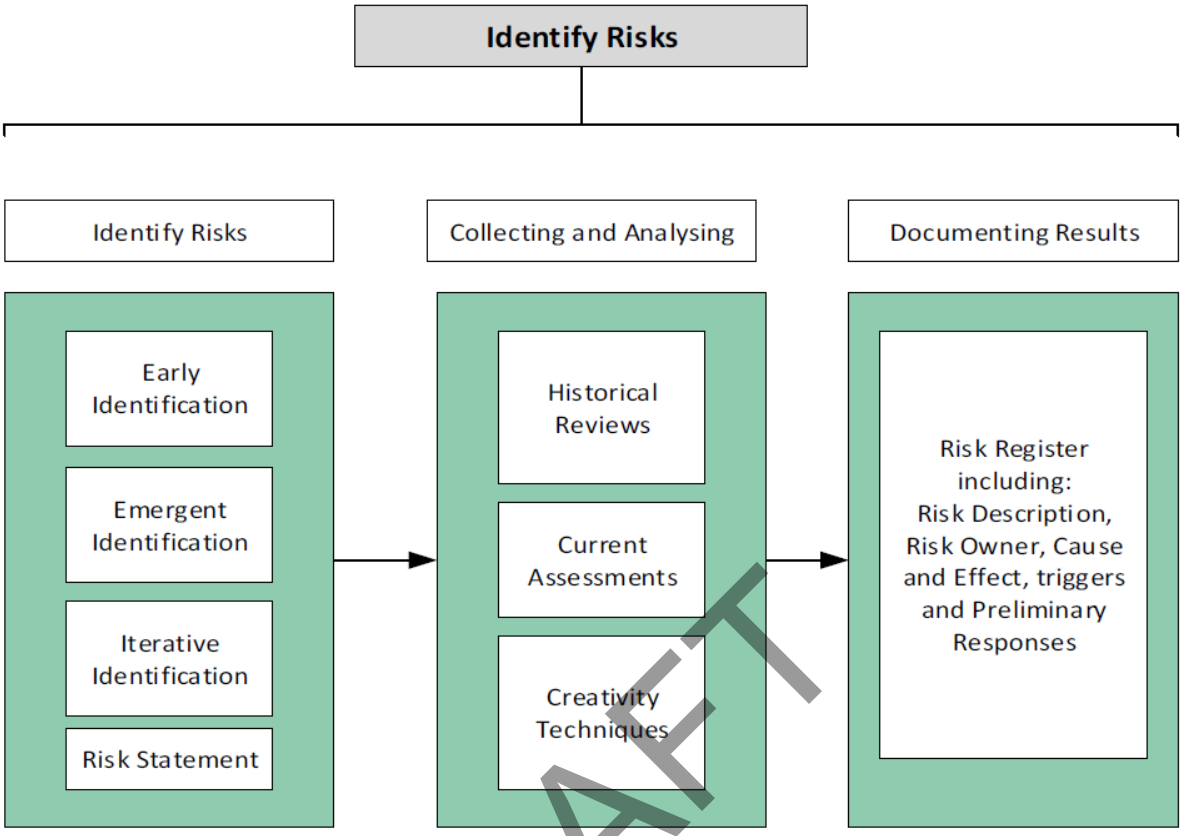


Figure 4: Risk identification

On commencing a new Program or Project that evolves a deliverable or deliverables, the Program/Project Manager should initiate an early risk identification meeting. Holding the early risk identification meeting will enable for key project/activity decisions to take maximum account of risks inherent in the project/activity, and may result in a change to the project strategy. Key inputs to the risk identification meeting will be the Cost Plan, Scope document and project Schedule. All involved team members and stakeholders should be included in the early risk identification meeting. Risks identified in the early risk identification meeting should be all documented in the NEOM Risk Register.

For not all risks can be identified at any stage of the program/activity, risk identification should be repeated through the program lifecycle. This iterative risk identification should be done periodically, and prior to the completion of key milestones in the program/task or whenever there is a significant change in the program/activity operating environment. However, all risk identified at any stage or time of the lifecycle of the program shall be formally documented in the NEOM Risk Register.

In addition to invoking the Identify Risks process as defined in the program plan, the Program Risk Management plan permits risks to be identified at any time, not limited to formal risk identification of events or regular reviews. In such a case, emergent identified risks at any stage or time of the lifecycle of the program shall be formally documented in the NEOM Risk Register.

Refer to Appendix A for sample risks sorted by risk category.

When to Identify Risks:

Table 6: When, what and how to identify risks

When	What	How
Project/Program Start Up	Startup Risk Meeting, all Stakeholders Involved	Meeting – Update Risk Register
Risk meeting	Regular Risk meeting where Risks are identified and Controlled	Meeting – Update Risk Register
Project Stage-gates	Part of the Stage-gate process will be to review and identify risks for the next stage of the Project	Meeting – Update Risk Register
Ad-Hoc	Risks can be raised at any time on the project	Email or other communication with the Risk Manager to add risk to NEOM Risk Register

(i) This process of the Identified Risks will help identification of risks, as a checklist to ensure all the categories are being covered during risk identification exercises; and

Facilitate top down management of the risks, by organizing them into the discrete categories. When identifying Risks, it is important to consider the risk Statement for each Risk, therefore within the following structure must be imposed for each risk Statement.

- Clearly describe the Risk Event that has an effect on the Program/Project Objectives (Time/Cost/Quality/Reputation etc.).
- State the Cause/causes.
- State the Consequences to the Program/Project Objectives if the risk is realized.

The Program / Project team need to deploy a variety of proven Risk Identification methods and techniques that will enable pragmatic Risk Identification:

- Source identification: The core NEOM team should be exploring all the potential sources that can help them to identify risks. Teams and individuals, government agencies and ministries organizations, consultants and suppliers can become excellent sources of risks identification.
- Meetings and Workshops: The Program / Project Team should held Risk Identification meetings and workshops from the early stages of a Program or Project engaging all the stakeholders. The NEOM Risk Manager should be the facilitator, responsible for the engagement and the active participation of the stakeholders. The Risk meetings can take the form of “Brainstorming” sessions in the early project stages, enabling all the participants to express their views and opinions freely and openly. At later project stages, after the development of the Risk Register, the Risk meetings can have a more formal structure as determined by the Risk Manager.
- Interviews with key stakeholders can provide a valuable source of risk identification. The interviews can be formal, or informal; held in one-to-one sessions, or include more representatives. Interviews are highly recommended for strategic and politically sensitive risks, where discretion is required.
- Existing data and documents: The NEOM team should utilize existing project documentation such as Project Charter and Assumptions log ensuring that previously identified risks are being captured. Records and documents from third parties, associated with the project such as reports, maps and studies should also be considered.

Past experience and good judgement should be utilized by all stakeholders. During the risk identification process the team and Risk Manager should maintain an ‘open’ approach, not excluding any of the potential risks identified before implementing risk data analysis.

5.3. Risk Breakdown Structure (RBS)

The purpose of this Risk Breakdown Structure is to help with the identification of risks, as it ensures all the categories are being covered during risk identification exercises. The RBS remains at a high level at PMO level, as it avoids being too prescriptive at lower levels, which will allow the flexibility for the NEOM Representative/Consultants/Contractors to expand on it at lower levels. Assumptions Log is usually prepared for each Asset or System. After identifying the Assumption, the Project Objective at Risk, how it would be impacted then the Risk Category can be identified. It is important that each RBS is mutually exclusive so that each entry has only one RBS.

The Risk Management Plan includes the following RBS levels:

- Level 1 – High Level Risk Categories.
- Level 2 – External Risk Categories, Internal Risks categories will be defined at project scope definition Stage.

Table 7: When, what and how to identify risks

Risk Influence Levels	Risk Event Source	Category Characteristics	Response Characteristics
External - Uncontrollable	The event occurs due to **circumstances outside of the control of the project**.	The Client and project team have no control over the occurrence or the impact of the event.	Provide contingencies to cater for the impact of occurrence of the event.
External – Influencable	The event occurs due to **circumstances outside of the control of the project**.	The Client and/or project team have a degree of influence over the probability and impact of the occurrence of the event.	Plan actions to influence the probability of the event occurring. Provide contingencies to cater for the residual impact of occurrence of the event
Internal - Client operations	The event occurs due to **action(s) taken by the Client organisation.**	The Client has control over the probability of the event occurring. The project team has no influence over the probability or the impact of the event occurring.	The project team draws to the attention of the Client the ramifications of planned or implemented actions. The project team plan actions to reduce the impact of the event. The project team define contingencies to cater for the residual impact of occurrence of the event.
Internal - User requirements	The event occurs due to **action(s) taken by the Client and the project team**	The Client and the project team have joint control over the probability of occurrence of the event The Client has control over the impact of occurrence of the event.	Plan actions for the Client and project team to implement that reduce the probability and impact of the event occurring. Provide contingencies to cater for the residual impact of occurrence of the event
Internal - Project processes	The event occurs due to action(s) **taken by the project team.**	The project team has control over the probability of occurrence of the event. The project team has control over the impact of occurrence of the event.	Plan actions for the project team to implement that reduce the probability and impact of the event occurring Provide contingencies to cater for the residual impact of occurrence of the event

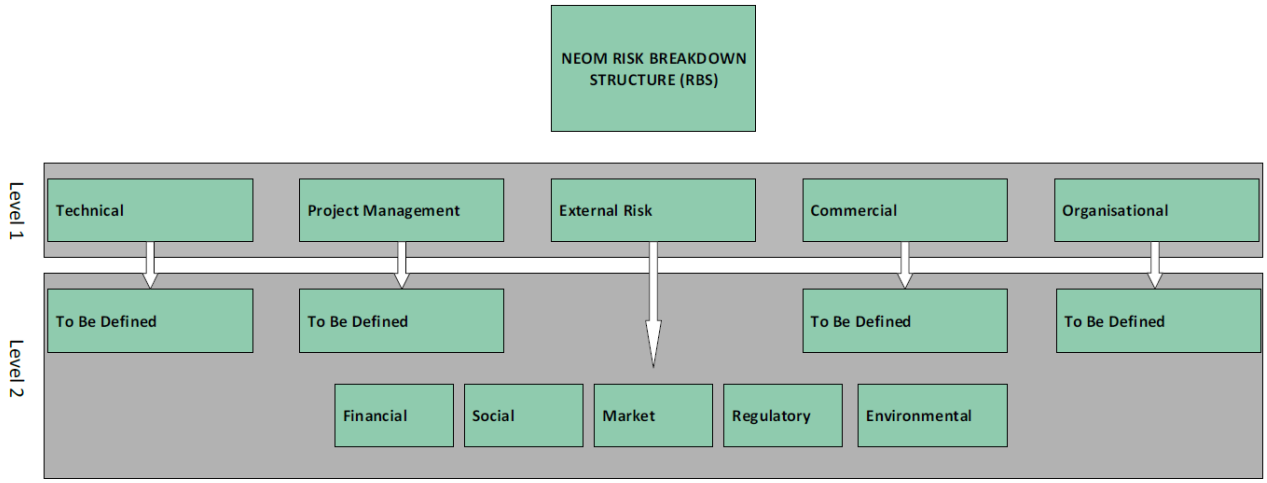


Figure 5: NEOM RBS

The NEOM RBS comprises Technical, Project Management, Financial, Social, Market, Regulatory, Environmental, Commercial, Organisational. Here below is a breakdown of one category in the RBS to provide a more detailed check-list:

Table 8: Risk breakdown structure

Risk Breakdown Strucutre

Technical Risk	1.1	Scope definition	Scope changes may arise during portfolio component implementation. Redundant scope may be discovered
	1.2	Requirements definition	Client may introduce significent change during portfolio component implementation (positive or negative). Internal inconsistencies may cost within requirements. Key requirements may be missing from formal requirement specification.
	1.3	Estimates, assumptions & constraints	Basis of estimating may be wrong. Planing assumptions may be invalidated during portfolio monitor and control. Imposed constraints may be relieved or removed.
	1.4	Technical process	Standard process may not meet requirements of specific solution. New process may be required. Process may be improved and made more effective
	1.5	Technology	New technology may be developed during portfolio component lifetime. Technology changes may invalidate design
	1.6	Technical Interfaces	Unexpected interactions may occur at key interfaces. Data inconsistencies across interfaces may require rework. Key interfaces may be reduced
	1.7	Design	It may prove impossible to meet some requirements within design limitations. Reuse of existing of design elements may be possible
	1.8	Performance	Final solution may not meet performance requirements. Some performance requirements may be mutually exclusive
	1.9	Reliability & maintainability	Target reliability criteria may be unattainable with chosen solution. The use of innovative technology may improve reliability. Maintainability requirements may improse unacceptable design constraints
	1.10	Safety	ALARP solution may impose additional cost. Changes in safety regulations may require significant redesign
	1.11	Security	Security implications may be overlooked during design. Government regulations may change during portfolio monitor & control
	1.12	Test and acceptance	Test protocols may reveal significant design error requiring rework. Client may withhold final acceptance for reasons outside contract

The NEOM team should analyze the risk data and information utilizing data analysis techniques such as Root Cause Analysis and SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis. Further analysis is required on the Assumptions Log to verify the validity and relevance of previously made assumptions and constraints.

Ishikawa diagram (Appendix B):

The Fishbone diagram included in Appendix B is a very simple tool that permits effective and quick root causes in the pursuit of corrective actions. It is also called as Ishikawa diagram and cause and effect diagram. It is a simple tool that is used for brainstorming issues and reasons of particular problems. Basically, there are various causes grouped into several categories highlighting the causes of the potential issue.

The core aim of this diagram is to brainstorm all the potential causes that could cause the difficulty and then go deep inside the factors that are causing the problem eventually. Once the problem is found, they eliminate them which enable the team to focus on why the problem has occurred. Also, it lets you

focus on the symptoms or history of the problem. Moreover, analysts can see the real time snap-shot of the collective inputs of the team.

Generally, this Fishbone diagram is used to present causality and it has two causes, primary and secondary cause. The first one is the primary cause that could directly lead to the effect while the secondary cause is the one that could lead it to a primary cause which does directly does not have an end effect.

Typically, the Ishikawa diagram is used to determine factors that could potentially lead to a major, overall effect, particularly in quality defect prevention and product design processes. As mentioned above, the causes are grouped into key categories so as to be able to recognize sources and causes for any variations. Those categories included the following.

- Methods: This section covers the details of the process and some specific requirements for doing it, such as procedures, rules, policies, regulations and laws.
- People: They are the ones who are involved in the process.
- Machines: These are the computers, tools, and equipment that are used to fulfill the activity and job.
- Measurements: This is the data that is generated from the process used to evaluate its quality.
- Environment: These are the conditions, time, location, temperature, and culture in which the process operates.
- Materials: These are the parts, raw materials, paper, pen that is used to produce the final product.

These elements and causes mentioned above are categorized separately in the Fishbone diagram.

See Appendix B for assumption log, constraint log, stakeholder register and Ishkawa template and risk register template.

All the information provided should be recorded and transferred to the Risk Register for further analysis.

5.4. Risk Assessment and Risk Analysis

Risk Assessment on Projects, Programs and Portfolios: The following paragraphs assess the benefits of risk assessment for a project, program and portfolio.

Benefits for a Project:

Project contingency can make or break a project. Having too much contingency is uncompetitive; having too little contingency increases the chance of failure. Risk assessment, or allowing for uncertainty within estimates, helps set contingency levels, with a preferred level of risk, and gives the confidence level of outcome targets.

Contingency is often set at the activity level, and it is common to add some contingency to every estimate. The amount of contingency added may even be a fixed amount such as 10 percent (10%), for example. However, it is much better to set contingency at the project level. In other words, use the ranges on the activity estimates to understand what contingency should be set for the project as a whole. Setting contingency at the project level reflects the reality that some activities may be delayed whereas others may be completed on time or be finished early. The amount of management reserve can be set by the same principle - allowing drawdown against risks that were identified at the start of the project.

In addition to setting the right level of contingency, risk assessment also benefits the project team by giving it a forum for expressing concerns and for challenging or defending assumptions. Removing the restriction of having to work with deterministic (single-point) estimates allows team members to give open and honest opinions of what is likely to happen. A risk assessment workshop is an important occasion for the project team to come together. It can lead to discussion and clarification of the scope

of project activities, and missing work is often identified. As a result of the workshop, the project team reaches an improved awareness and understanding of the status of the whole project. Although the cost and schedule disciplines for a project are often separate, it is important for these groups to confer with each other. A risk assessment workshop can bring these disciplines together.

Risk assessments also enable risk response and mitigation strategies to be expressed. Cost/benefit analysis can be used to compare risk mitigation strategies and understand how effectively the money would be spent. When the cost of implementing the response is included in the comparison, it can show the net effect of the response on the project cost. The response can then be judged in terms of whether its net effect is to increase cost and whether that increase can be justified by the time it saves. Assessing risk mitigation strategies makes it possible to fully understand their effects.

Risk assessment enables contracts to be fairly negotiated, bids to be submitted at the right price, and sensitivity to be appreciated. In summary, risk assessment means that the project is better understood, can be better planned and managed, and can be more profitable.

Benefits for a Program and Portfolio:

Assessing the risk facing a group of projects leads to a better overall view of risk to the portfolio. Looking at the entire program or portfolio enables individual projects to be compared and understood in terms of their risk. This helps in selection of projects and focusing of management attention on the projects that most need it.

Contingency is best set at a program or portfolio level. Although not every project will suffer from risk, some will, but don't know which ones. Management reserves for the portfolio can be set and drawn down by adherence to the same principles as those discussed in the previous Section.

Projects in a portfolio often have interdependencies, shared resources, and shared goals. In risk assessment, they need not be considered in isolation. At the program and portfolio level, it is important to express risk arising from project interdependency. Risk at the program or portfolio level can be shared and balanced across projects as a way of mitigating it.

In summary, risk assessment enables you to better understand and manage the program or portfolio as a whole. You can use the whole weight of the program or portfolio to manage the risk.

Qualitative risk analysis is the process of prioritizing the identified risks for auxiliary action, for instance risk response plan. The Project Risk Management Team (PRMT) will be able to enhance the program's performance efficiently by directing more focus on high-priority risks. Revisiting the qualitative analysis done in the early stages of the lifecycle of the program/activity, will also be essential in accelerating the close out of risks or the improvements of the risk response plan implemented. When the team repeats the qualitative analysis for individual risks, trends may emerge in the results.

These trends can indicate the need for more or less risk management action on particular risks or even show whether a risk mitigation plan is working.

After all Qualitative Risk Analysis the following can be produced:

- Update of Risk Register.
- Production of Risk Report.
- Assumption Log Updated.

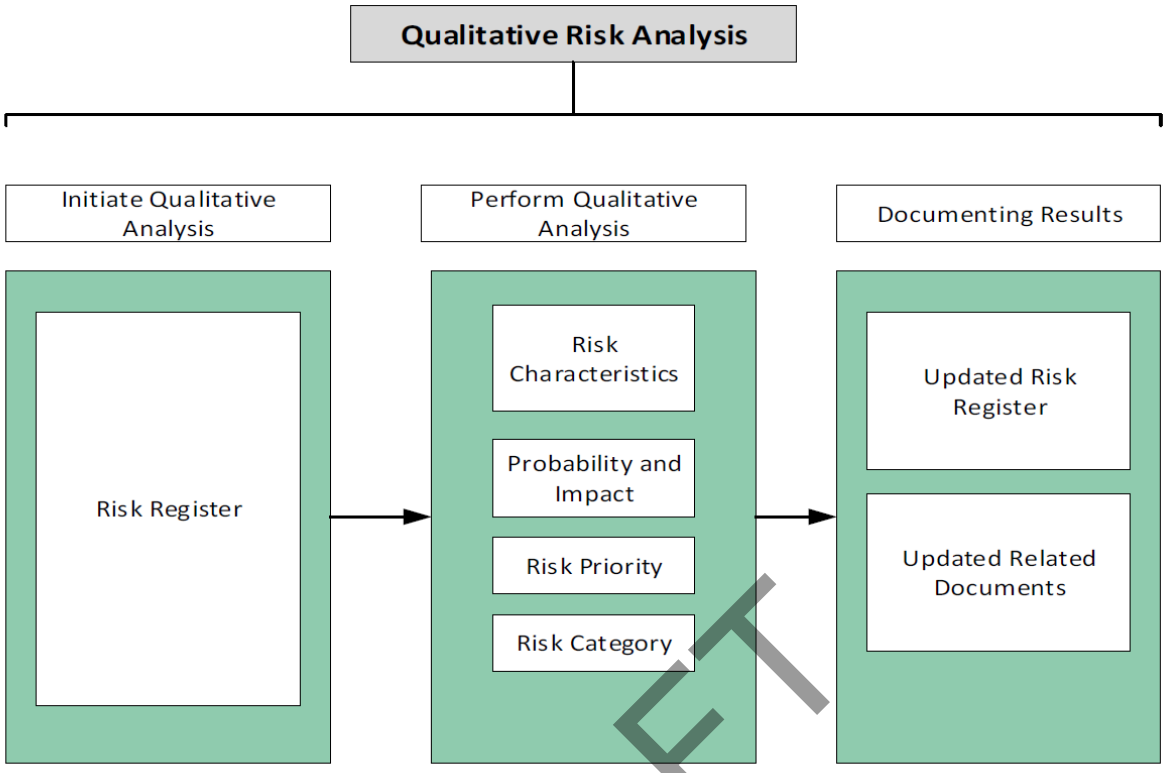


Figure 6: Qualitative risk analysis

Qualitative risk analysis for all project and Programs allocates a Probability and an Impact rank to each risk in the risk register. The Overall Rating will then be automatically calculated and determined allowing the Risk Manager to spot where the utmost effort should be dedicated in responding to the risks.

Probability: Below table identifies the risk rating system that should be used in assessing the probability for each identified event. The ratings for the program serve as a consistent frame of reference for the Program/Project Risk Management teams in assessing the risks during the lifecycle of the program.

The Probability rating will be used for all levels of risk management within NEOM.

Table 9: Probability rating

Probability Rating					
	1	2	3	4	5
	Very Low	Low	Moderate	High	Very High
Probability Rating	1-15%	16-30%	31-65%	66-80%	81-95%

Table 10: Probability versus impact (opportunity and threat)

		Impact									
		Opportunity					Threat				
		Very High	High	Medium	Low	Very Low	Very Low	Low	Medium	High	Very High
		2	3	4	5	6	7	8	9	10	11
Probability	Very High	25	22	15	10	5	-5	-10	-15	-22	-25
	High	24	21	14	9	4	-4	-9	-14	-21	-24
	Medium	23	18	13	8	3	-3	-8	-13	-18	-23
	Low	20	17	12	7	2	-2	-7	-12	-17	-20
	Very Low	19	16	11	6	1	-1	-6	-11	-16	-19

Likelihood/Impact Scale
VH - Very High
H - High
M - Medium
L - Low
VL - Very Low

Opportunity Risk Rating Scale
Critical Opp
Major Opp
Significant Opp
Minimal Opp

Threat Risk Rating Scale
Critical Threat
Severe Threat
Significant Threat
Negligible Threat

Table 11: Likelihood

LIKELIHOOD

Description	Scenario	Code Letter	Guide Probability
Very High	Almost certain to occur	VH	>75%
High	More likely to occur than not	H	>50% ≤75%
Medium	Fairly likely to happen	M	>25% ≤50%
Low	Low but not impossible	L	>5% ≤25%
Very Low	Extremely unlikely to happen	VL	≤5%

Table 12: Impact

IMPACT

Description	Scenario	Code Letter	Cost Impact	Time Impact
Very High	Critical impact on the achievement of objectives and overall performance. Huge impact on costs and/or reputation. Long-term effect.	VH	>10% of total capital cost	>10% of total schedule duration
High	Major impact on costs, objectives. Serious impact on output and/or quality and reputation. Medium to long-term effect.	H	5% to 10% of total capital cost	5% to 10% of total schedule duration
Medium	Impacts project resources, operational efficiency, output, and quality. Medium term effect.	M	2.5% to 5% of total capital cost	2.5% to 5% of total schedule duration
Low	Minor impact, loss/gain, delay, inconvenience or interruption. Short to medium term effect.	L	1% to 2.5% of total capital cost	1% to 2.5% of total schedule duration
Very Low	Minimal loss/gain, delay, inconvenience or interruption. Can be easily and quickly remedied if needed.	VL	<1% of total capital cost	<1% of total schedule duration

The Probability has 5 different levels, each with a different percentage likelihood of probability. The top level of Probability is 95%, anything over, the item would be deemed as a certainty (issue) not a risk.

Impact Rating:

As well as being assigned a probability rating, each risk needs to be assigned an Impact rating. Within the hierarchical structure of NEOM there will be risk registers assigned by differing organizations at varying levels of the EPM, and all of the different projects will have different budgets, schedule durations and different ratings. Therefore, it is appropriate that the Impact scale is appropriate to the program/project scale.

As yet, the timeline and budgets for the PMO L1 master schedule have not been developed, so the impact ratings for risk purposes have not been confirmed for the PMO. However, an example of the impact rating that could be used is detailed below in the table below.

It is understood that risks could have different impacts for cost and schedule, and as such the Risk Register allows for a different impact rating for cost and Schedule.

Table 13: Impact definitions

Impact Definitions					
Rating	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Cost Impact of Threat	Insignificant cost increase	<5% cost increase	5-10% cost increase	10-20% cost increase	>20% cost increase
Cost Impact of Opportunity	Insignificant cost reduction	<1% cost decrease	1-3% cost decrease	3-5% cost decrease	>5% cost decrease
Schedule Impact of Threat	Insignificant slippage	< 1month slippage	1-3month slippage	3-6month slippage	>6month slippage
Schedule Impact of Opportunity	Insignificant improvement	< 1month improvement	1-2month improvement	2-3month improvement	3month improvement
Probability	1-15%	16-30%	31-65%	66-80%	81-95%

The PRMT evaluates each identified risk in turn and evaluates:

- The rating for the probability of the risk occurring.
- The rating of cost and time impact of each risk, should it occur.

For this allows the event to be prioritized into a traffic signal system with risks that falls within the red zone would be given high importance, yellow is medium importance, and green is low importance.

The table below shows an indicative approach to how impact and probability are combined to provide a risk Score or Rating.

The NEOM risk approach identifies a risk score for cost and schedule, and combines the scores to give a total score. Only the impact to cost and schedule are numerically scored, other risk categories are scored within their cost or schedule implications.

Table 14: Risk matrix

Risk Matrix						
Probability Rating	**5 - Very High**	**5**	**10**	**20**	**35**	**50**
	4 - High	**4**	**8**	**16**	**28**	**40**
	3 - Moderate	**3**	**6**	**12**	**21**	**30**
	2 - Low	**2**	**4**	**8**	**14**	**20**
	1 Very Low	**1**	**2**	**4**	**7**	**10**
		1	**2**	**3**	**4**	**5**
		very Low	**Low**	**Moderate**	**High**	**Very High**
		Impact Rating				

Pre and Post Mitigation Assessment and Estimate

The purpose of having the pre and post mitigation is to quantify the effect of risk mitigation actions on individual risks, and potentially but also to quantify the collective value added to a project as a consequence of its risk mitigation plans.

1- Pre-mitigation assessment: After understanding a risk and developing a risk description, to make estimates for the risk's probability and impact in the context of the project's current plan and objectives.

2- Identify proactive mitigation actions that reduce the risk probability and/or impact by addressing sources of risk or planning a fallback.
3- Post-mitigation assessment: Finally, to re-estimate the risk on the basis that all the identified mitigation actions that have been authorized will be implemented as planned. Authorized proactive actions that:
    i. Change the project plan,
    ii. Address sources of uncertainty, or
    iii. Identify fallbacks to reduce impact

    Note: actions not yet authorized do not contribute to post mitigation assessment

Although the use of pre- and post-mitigation has become increasingly common practice, the following definitions are recommended:

Pre-mitigation: current risk exposure assuming that the risk is accepted with no specific actions in response.
Post-mitigation: current risk exposure assuming that specific authorized actions will be implemented.

Benefits of pre and post mitigation assessment and estimate are:

- Quantifying the value added by risk mitigation actions to individual risks – the cost, time and resource utilization implications of actions can be weighed against the benefits of reduced risk exposure, thus helping to choose an appropriate mitigation plan for each risk.
- Quantifying the collective value added to a project as a consequence of its risk mitigation plans.

All the above-mentioned information will be reported on the below Risk Register:

Table 15: Risk register

Risk Register															
Category (from RBS)	ID	Risk	Pre-Mitigation Assessment				Pre-Mitigation Assessment				Mitigation Risk	Residual Risk	Secondary Risk	Contingency Risk	Revised Risk
			Probability	Impact	Score	Rank	Probability	Impact	Score	Rank					

Quantitative risk analysis is a way of numerically estimating the probability that a program will meet its cost and time objectives, this process starts after the Qualitative Analysis (Initial and or Detailed) and at the Define stage of Program. Quantitative analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. The result is a probability distribution of the program's cost and completion date based on the identified risks in the program.

After all Quantitative Risk Analysis the following can be produced; NEOM is using the Monte Carlo Analysis model to perform Quantitative Risk Analysis.

Using Risk Scores:

Risk Response and Mitigation is detailed in the next section of the Risk Management Plan, however on the risk register, each risk needs to be assigned a response strategy to have the risk score reduced.

Both the original Risk Score and the mitigated Risk Score will be modelled in the Monte Carlo Analysis to provide a comparison on the outcomes (cost/Schedule) of the project/Program.

3-Point Estimates:

Every risk needs to be assigned three (3) estimates for Cost, Schedule and Quality impact, to be used in line with the ranges of cost/schedule impact given by the mitigated risk score in the Qualitative assessment.

- Minimum – minimum (cost/Schedule) impact that this risk could cause if the risk actually occurred (to be displayed in SAR currency and Unit of time (Day/week/month etc.).
- Most Likely – Most likely (cost/Schedule) impact that this risk could cause if the risk actually occurred (to be displayed in SAR currency and Unit of time (Day/week/month etc.).
- Maximum - Maximum (cost/Schedule) impact that this risk could cause if the risk actually occurred (to be displayed in SAR currency and Unit of time (Day/week/month etc.).

Risk Analysis is subjective and the results can be vastly altered by the values input for the three point estimates. Therefore, it is important to give them careful consideration:

- Use historical data – where possible.
- Ensure the right people are having an input into the estimates, experience and knowledge are key.
- Apply a consistent approach to the estimates.
- Update of Risk Register.
- Production of Risk Report.
- Assumption Log Updated.
- Assign the Risk to the Correct Schedule activity.

Once the 3-point estimate is complete, the individual risks must be assigned to the relevant activity within the schedule that carries the risk, this will assist when modelling the risk within the correct phase of the project.

Using Software to Model the Risk:

NEOM will use Primavera Risk Analysis (PRA) to model Quantitative Risk. The Schedule from Primavera gets loaded in to the PRA software and the cost/schedule estimates are also input in, which should mirror what is shown on the NEOM risk register.

The PRA software then runs the Monte Carlo analysis, which is essentially hundreds or thousands of statistical iterations passing through the schedule.

Probability – depending on the probability of each risk, the risk will be realised within the iteration. An example is that if risk A has a 19% probability of occurring, and the software has been asked to perform 100 iterations, it will realize the risk 19 times.

Impact – When the software does realize the risk, it will use the 3-point analysis to model the impact of the risk using a probability distribution calculation.

Monte Carlo Results:

The purpose of using statistical analysis to model risk in the Quantitative Analysis, is that the results can provide information to assist with the Management of NEOM.

Schedule – QSRA:

The Quantitative risk Analysis will run all the iterations through the schedule with all the chances of risk incorporated. Each run through of the schedule will therefore produce a different completion date of the schedule.

The chart below is an example of the results produced by the model.

The results will determine what the percentage probability of completing the schedule on a given date.

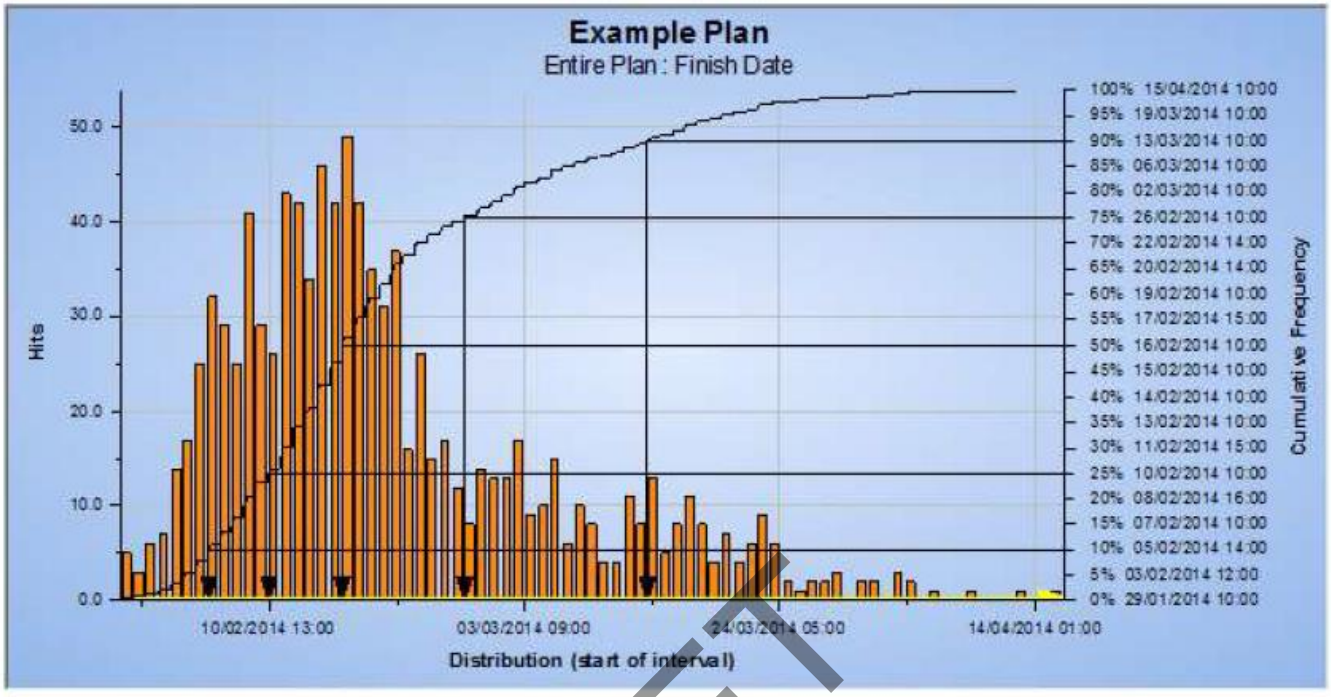


Figure 7: Percentage probability of completing the schedule on a given date.

Probability Histogram:

For NEOM a QSRA must be undertaken at various stages:

- Contract Program submitted – In order for a Schedule to be accepted the Schedule must have an 80% chance of meeting the required completion date (P80).
- Major Schedule Re-baseline – If there is a major change that greatly effects the sequencing of the schedule, the schedule will require re-submission with the P80 rule applying.
- Specific high risk items of work must conduct their own QSRA (P80).
- Annually a QSRA must be carried out on the live program using the live Risk Register (P80).

It will be the PMO responsibility that the PMC schedule is risk compliant, and the PMC responsibility to ensure the Contractors schedule is risk compliant.

A detailed QSRA process will be developed after the Strategy Stage for NEOM.

Cost – QCRA:

The results of the Risk Analysis for cost purposes will be used to quantify each programs/projects potential exposure to cost risk.

Depending on the specific contractual framework, the information can be used to allocate specific contingency budget to each program/project.

The Cost Management Plan will provide more detail in determining where the contingency will lie, i.e. client or contractor, but the important factor is that the Risk Analysis will help determine the amount to set aside.

5.5. Risk Response Planning

Risk response is the process of adopting strategic options, and defining actions, to maximize opportunities and minimize threats to the program's objectives. A program team member shall be to ownership of each risk that falls within their area of expertise. This process ensures that each risk requiring a response has an owner monitoring the responses, although the owner could however delegate implementation of a response to someone else.

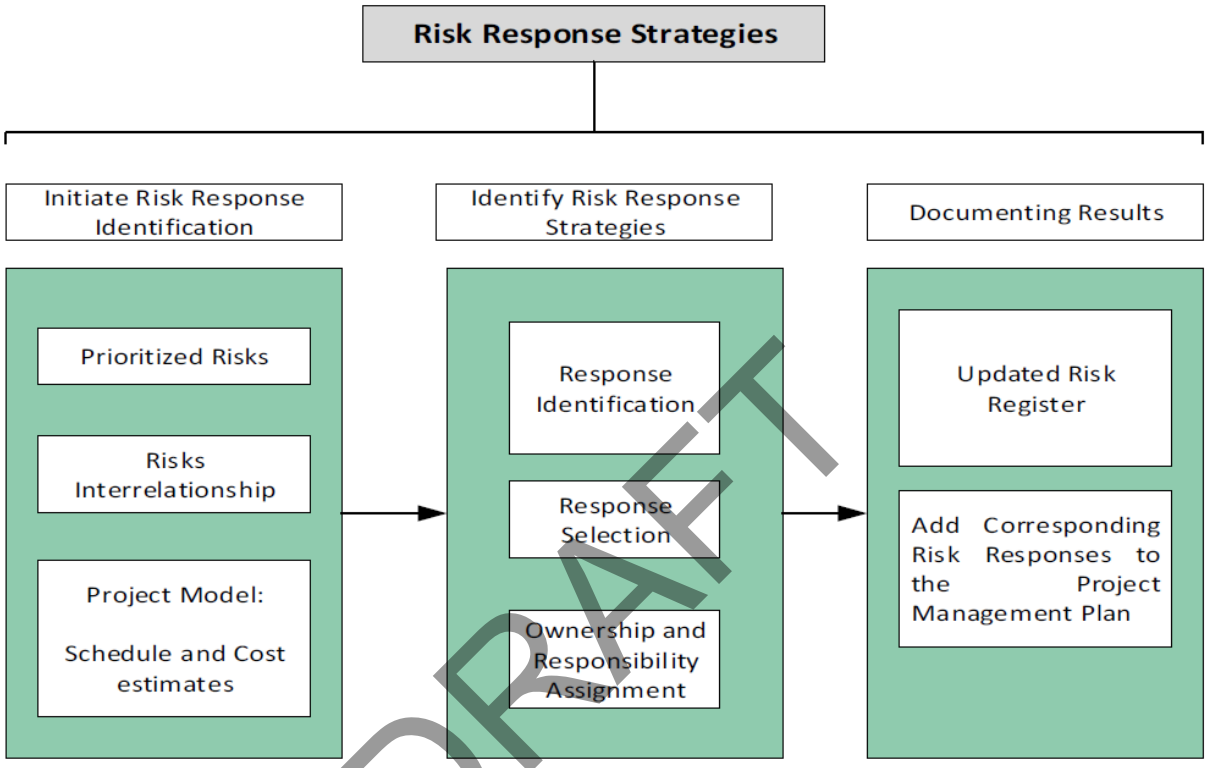


Figure 8: Risk response strategies

Table 16: Risk response strategies for risks and for opportunity

For Risks	For Opportunity
Avoid. Risk can be avoided by removing the cause of the risk or executing the program in a different way while still aiming to achieve program objectives. Not all risks can be avoided or eliminated, and for others, this approach may be too expensive or time-consuming. However, this should be the first strategy considered.	**Exploit.** The aim is to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with a particular upside risk by making the opportunity definitely happen. Exploit is an aggressive response strategy, best reserved for those "golden opportunities" having high probability and impacts.

Transfer. Transferring risk involves finding another party who is willing to take responsibility for its management, and who will bear the liability of the risk should it occur. The aim is to ensure that the risk is owned and managed by the party best able to deal with it effectively. Risk transfer usually involves payment of a premium, and the cost-effectiveness of this must be considered when	**Share.** Allocate risk ownership of an opportunity to another party who is best able to maximize its probability of occurrence and increase the potential benefits if it does occur. Transferring threats and sharing opportunities are similar in that a third party is used. Those to whom threats are transferred take on the liability and those to whom opportunities are allocated should be allowed to share in the
Mitigate. Risk mitigation reduces the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and/or impact of a risk is often more effective than trying to repair the Damage after the risk has occurred. Risk mitigation may require resources or time and thus presents a trade-off between doing nothing versus the cost of mitigating the risk.	**Enhance.** This response aims to modify the "size" of the positive risk. The opportunity is enhanced by increasing its probability and/or impact, thereby maximizing benefits realized for the program. If the probability can be increased to 100 percent, this is effectively an exploit response.
Acceptance. This strategy is adopted when it is not possible or practical to respond to the risk by the other strategies, or a response is not warranted by the importance of the risk. When the program Manager and the program team decide to accept a risk, they are agreeing to address the risk if and when it occurs. A contingency plan, workaround plan and/or contingency reserve may be developed for that eventuality.	

Following identification and analysis of program risks, the Risk Manager will take action to improve the odds in favor of program success. Ultimately, it is not possible to eliminate all threats or take advantage of all opportunities – but they will be documented to provide awareness that they exist and have been identified. Successful risk response will change the risk profile through the program life cycle, and risk exposure will diminish.

Risk response involves:

- Determining which risks warrant a response and identifying which strategy is best for each risk.
- Assigning an action to the Risk Owner to identify options for reducing the probability or impacts of each risk. The Risk Owner takes the lead and can involve experts available to the program.
- Evaluating each option for potential reduction in the risk and cost of implementing the option.
- Selecting the best option for the program.
- Requesting additional contingency, if needed.
- Assigning an action to the Risk Owner to execute the selected response action.

The Risk Owner is the lead and may assign specific activities to other resources to have the response implemented and documented. If the Risk Manager judges that a risk should be accepted, it may assign an action to the Risk Owner to prepare a contingency plan if deemed necessary.

Risk Perspective Can Enhance Decisions:

When considering risk mitigation strategy, it is important to recognize the impacts of the decision. The impact of responding to a risk may make sense in the short term (e.g. Saves design costs, allows team to meet schedule), but the impact of the risk needs to be taken as a whole.

Risk mitigation at NEOM involves the following steps:

- Identifying the various activities, or steps, to reduce the probability and/or impact of an adverse risk.
- Creation of a Contingency Plan to deal with the risk should it occur. Taking early steps to reduce the probability of an adverse risk occurring may be more effective and less costly than repairing the damage after a risk has occurred. However, some risk mitigation options may simply be too costly in time or money to consider.

Mitigation activities should be documented in the Risk Register, and reviewed on a regular basis. They include:

- Identification of potential failure points for each risk mitigation solution.
- For each failure point, document the event that would raise a “flag” indicating that the event or factor has occurred or reached a critical condition.
- For each failure point, provide alternatives for correcting the failure.

Risk Contingency Planning:

Contingency planning is the act of preparing a plan, or a series of activities, should an adverse risk occur. Having a contingency plan in place forces the program team to think in advance as to a course of action if a risk event takes place.

- Identify the contingency plan activities (or steps) that can be performed to implement the mitigation strategy.
- Identify the necessary resources such as money, equipment and labor.
- Develop a contingency plan schedule. Since the date the plan will be implemented is unknown, this schedule will be in the format of day 1, day 2, day 3, etc., rather than containing specific start and end dates.
- Define emergency notification and escalation procedures, if appropriate.
- Develop contingency plan training materials, if appropriate.
- Review and update contingency plans if necessary.
- Publish the plan(s) and distribute the plan(s) to management and those directly involved in executing the plan(s).

Outputs to Risk Response:

As an Output to Risk response it may be required to Update Project Plans and Documents – If a risk Response strategy, changes a method of working or a process then it may be required to update the relevant management plan to effect the change of process. Likewise, Project documents such as change registers, schedules etc. may need to be updated as a result of the Risk Management Process. The important factor to consider is that the Management of Risks, and the outcomes of the mitigation strategy will be one input into Change Requests (as the risk becomes an eventuality, or to increase the contingency), which will be detailed in the Cost Management Plan.

5.6. Risk Monitoring and Control

As program activities are conducted and completed, risk factors and events will be monitored to determine if in fact trigger events have occurred that would indicate the risk is now a reality. Based on trigger events that have been documented during the risk analysis and mitigation processes, the program team or program managers will have the authority to enact contingency plans as deemed appropriate. Day to day risk mitigation activities will be enacted and directed by the risk owners.

Contingency plans that once approved and initiated will be added to the program work plan and be tracked and reported along with all of the other program activities. Risk management is an ongoing activity that will continue throughout the life of the program. This process includes continued activities of risk identification, risk assessment, planning for newly identified risks, monitoring trigger conditions and contingency plans, and risk reporting on a regular basis.

Program status reporting contains a section on risk management, where new risks are presented along with any status changes of existing risks. Some risk attributes, such as probability and impact, could change during the life of a program and this should be reported as well.

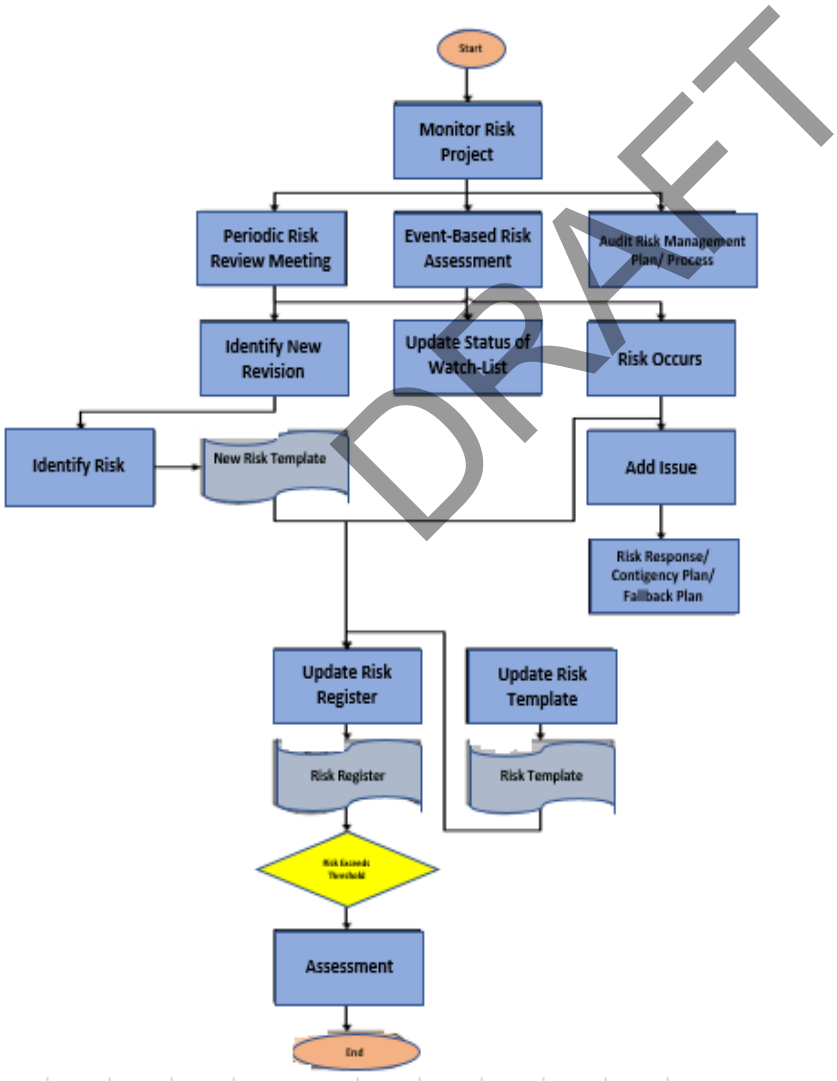


Figure 9: Process for monitoring risk

The NEOM Risk Management Team shall input to the monthly report, with the following Risk Summary:

- Top Risks.
- Highlight the overdue actions required on risk mitigation.
- Report Risk KPI's.
- Opportunities that have been realized.
- Any other major Risk concerns.

See Appendix C for project risk management reports.

Meetings:

As a minimum the PMO will conduct the following meetings to manage risk:

- Bi-Weekly Risk Meeting. This meeting is chaired by the Risk Manager and will include all PMO stakeholders identifying, mitigating and updating ongoing actions. – Following the meeting the updated Risk Register will be issued – Qualitative and Quantitative will get carried out within meeting.
- Quarterly Risk Workshops (may rise to Monthly later phases of the project) – Open to External stakeholders including PMC's, environmental, statutory etc. – PowerPoint will be issued after and Risk Register updated.
- QRSA workshops – when the PMO is required to carry out a QSRA, it can be done independently by the Risk Manager & Scheduler, or it can be done in a workshop to involve all stakeholders, and things like 3-point estimates can get challenged – As required.
- Commercial Risk Meetings – Meeting between Project Controls, Risk, Commercial and Project Manager to discuss Risk Contingency value, amount drawn on, updated forecast risk etc. – Monthly Meeting.
- Program Stage-Gate Risk Meetings – at each Gate process, risks will be reviewed from previous phases to check validity for the next phase, and risks will be identified/mitigated for the next phase.

Risk Audits:

The Risk Process & documents will undergo a regular examination to determine the effectiveness in the following areas:

Compliance to Plan:

- Do the Process Comply with the Risk Management Plan, i.e. are the risk meetings happening.
- Are the Documents being utilized in accordance with the Risk Management Plan.
- Are the tools and Techniques (i.e. QSRA) complying with the Risk Management Plan.

Effectiveness of Plan:

- Are the documents Correct, up to date or do they need changing/amending.
- Is the process effective, are there issues, does it need to be changed.

The Audit will include a mix of gathering document evidence and interviewing team members and analyzing outcomes of Risk mitigation strategies. The Risk Auditing process should be requested by the NEOM Project Manager, controlled by the NEOM Risk Manager and implemented by the NEOM PMO Risk Specialist(s). It should be undertaken on a project by project basis and applied on projects with duration more than 6 months.

Risk Auditing should be performed periodically at 33% increments of the overall project duration. Additionally, Risk Auditing should taking place when there is failure to identify and mitigate risks, as well as when the Project Manager deems necessary. The Risk Auditing results should be recorded and reported, including the non-compliance areas as well as the appropriate recommendations for

improvements. When the Risk Management Process is not deemed effective, the NEOM project manager and NEOM.

Risk Manager should consider:

- Review of the Risk Process -design and implementation.
- Required Risk Management Training.
- Request Compliance from the project team members.

Data analysis:

The storage of information is Key within the NEOM Risk Management Process. The Program timescale will be over 20 years, upon which multiple risks will be identified, mitigated, managed or realized. By storing and analyzing the data, more information will be known about the most successful strategies for managing specific risks, as well as making it easier to identify new risks. All risk information will be stored and analyzed to build up trend reporting for risks (needs developing).

The Project Risks should be reported at the Project and Program level on a monthly basis and should include at a minimum:

Risk Register

- Top 10 Risks (Scoring and Status).
- Top 10 Issues (Scoring and Status).
- QSRA Results and required mitigation actions.
- Risk Budget and allocation S-Curve.

Software to be used:

Oracle Prime Projects provides a risk management solution integrated with both qualitative and quantitative risk analysis capabilities to help determining the impact of risk and uncertainty on the project. Using the application, one can identify and prioritize potential threats and opportunities that exist for the project. For further analysis, one can run a quantitative analysis which examines the project schedule with risks and uncertainties, and calculates the chance that the project will be completed within a given period of time and budget.

Key Features of the Software:

- Log all project risks in a risk register and manage their details, including descriptions, status, probabilities, impacts, and other information.
- Use workflows and forms to create and review proposed risks for approval.
- Prioritize project risks based on risk scoring criteria defined for the project.
- Run a Monte Carlo analysis using project schedule and risk data to produce probability curves showing expected time and cost outcomes and the probability of achieving each.
- Develop risk response actions to address project risks and establish post-response contexts.
- Track risk exposure to CBS codes and have cost information roll up to the project cost sheet.

Table 17: Risk register/log

1. BASIC RISK INFORMATION					2. RISK ASSESSMENT INFORMATION					3. RISK RESPONSE INFORMATION		
Risk Number	**Risk Description / Risk Event Statement**	**Responsible**	**Date Reported** day-month-year	**Last Update** day-month-year	**Impact** H / M / L	**Impact Description**	**Probability** H / M / L	**Timeline** N/M/F	**Status of Response** N / P / PE / EE	**Completed Actions**	**Planned Future Actions**	**Risk Status** Open / Closed / Moved to Issue
Provide a unique identifier for risk	*A risk event statement states (i) what might happen in the future and (ii) its possible impact on the project. "Weather" is not a risk event statement. "Bad weather may delay the project" is a risk event statement.*	*Name or title of team member responsible for risk*	*Enter the date the risk was first reported*	*Enter the date the risk (not the entire log) was updated*	*Enter here H (High); M (Medium); or L (Low) according to impact definitions*	*List the specific impact the risk could have on the project schedule, budget, scope, and quality. Other impacts can also be listed*	*Enter here H (High) M (Medium) or L (Low) according to probability definitions*	*Enter here N (Near-term); M (Medium-term); or F (Far-term) according to timeline definitions*	*Enter here N (No Plan); P (Plan but not enacted); PE (Plan enacted but effectiveness not yet known); EE (Plan enacted and effective)*	*List, by date, all actions taken to respond to the risk. This does not include assessing the risk*	*List, by date, what will be done in the future to respond to the risk*	*State if the risk is open (still might happen and still has to be managed); closed (has passed or has been successfully mitigated); moved to issue (risk has happened)*

6. Forms/Templates

NEOM-NEN-PRC-028_FRM01: Assumption Log (enclosed in Appendix B)

NEOM-NEN-PRC-028_FRM02: Constraint Log (enclosed in Appendix B)

NEOM-NEN-PRC-028_FRM03: Stakeholder Register (enclosed in Appendix B)

NEOM-NEN-PRC-028_FRM04: Risk Register Details Form (enclosed in Appendix B)

NEOM-NEN-PRC-028_FRM05: Project Risk Management Monthly Report (enclosed in Appendix C)

NEOM-NEN-PRC-028_FRM06: Risk Summary Form (enclosed in Appendix C)

7. Reference

Project Management Body of Knowledge 6th edition

8. Appendices

Appendix A: Sample Risks by Category

Appendix B: Assumption Log, Constraint Log, Stakeholder Register and Ishkawa Template and Risk Register Details Forms

Appendix C: Project Risk Management Monthly Report Form

Appendix A

Sample Risks by Category

Risk Category	Risk Category	Risk	Risk Type
Authorities & Regulations	Authorities & regulations	· Unclear requirements for authority approvals and NOCs	External - Uncontrollable
Client Approval		· Unclear requirements of authorities	External – Can be influenced
Construction		· Delays in obtaining permits	Internal - Client operations (controllable)
Design	Construction	· Delays in attaining permits	Internal - User requirements (controllable)
Commissioning & Handover		· Quantity of materials	Internal - Project processes (controllable)
Procurement		· Quality of materials	
Project Cost		· Delays in material	
Resources		· Issues in site accessibility	
Schedule		· Excessive claims for variations	
Scope & objectives		· Poor sub contractor management	
Site Conditions		· Traffic delays and issues	
Stakeholders		· Inexperienced contractor staff with UAE regulations	
Utilities		· Schedule not optimized for delivery timeframes	
		· Delays to NOIs	
		· Contractor to reduce work on site	
		· Inadequate contract supervision	
		· Non optimal management of claims and delays	
		· Delays in approval of site office	
	Design	· Incomplete / inaccurate drawings	
		· Errors in BOQ	
		· Unresolved design issues or decision	
		· Design does not address functional or operational issues	
		· Design does not take into account operational costs	
		· Unclear change control process	
		· Schedule not optimized for delivery timeframes	
		· Delays in the design review process	
		· Delays in the design NOCs	
		· Delays in resolving design issues with authorities or stakeholders	
		· Design exceeds project budget	
		· Unrealistic schedule	
		· Delays to NOIs	
	Procurement	· Schedule not optimized for delivery timeframes	
		· Unrealistic Project Schedule	
		· Non optimal procurement approach	
		· Incomplete tender documents	
		· Delays in long lead items	
		· Delay in approval of equipment	
		· Delays in the procurement process	
	Project Cost	· Rates used do not reflect market conditions related to the project	
		· Optimism in the cost estimate	
		· Cost estimate does not account for complexities in the project	
		· Cost estimate does not allow for the life cycle costs associated	
		· Misalignment with project schedule and cash flow	

Appendix B

Assumption Log, Constraint Log, Stakeholder Register and Ishikawa Template and Risk Register Details Forms

NEOM نيوم

NEOM-NEN-PRC-028_FRM01

ASSUMPTION LOG

Contract Number:		Originator:	
Project/Asset Name:		Date:	
Filled by:		Submitted to:	

ID	Category	Assumption	Involved Stakeholder	Maturity Date	Contractual Yes/No	Status	Notes

Category: Choose one of those: Financial, Design, Execution, Logistic, Schedule, HSE, Cost, Quality, Political, Procurement, Legislative, Other.

Assumptions: Uncertainties that are considered to be true for the sake of planning. Assumptions might be risks.

Involved Stakeholder: Stakeholders who might cause the constraint or impose on assumption.

Maturity Date: When the assumption is no longer valid.

Contractual: Imposed by Contract.

Status: Valid, Managed, Invalid.

NEOM نيوم

NEOM-NEN-PRC-028_FRM02

CONSTRAINT LOG

Contract Number:	Originator:
Project/Asset Name:	Date:
Filled by:	Submitted to:

ID	Category	Constraint	Involved Stakeholder	Maturity Date	Contractual Yes/No	Status	Notes

Category: Choose one of those: Financial, Design, Execution, Logistic, Schedule, HSE, Cost, Quality, Political, Procurement, Legislative, Other.

Constraints: Boundaries or limitations imposed to the project. Constraints might be causes for risks.

Involved Stakeholder: Stakeholders who might cause the constraint or impose on assumptions.

Maturity Date: When the constraint is no longer valid.

Contractual: Imposed by Contract.

Status: Valid, Managed, Invalid.

NEOM نيوم

NEOM-NEN-PRC-028_FRM03

STAKEHOLDER REGISTER

Contract Number:	Originator:
Project/Asset Name:	Date:
Filled by:	Submitted to:

ID	Name	Position	Role	Phase/ Lifecycle	"Expectations/ Interests"	"Influence/ Power"	Classification	Status

NEOM-NEN-PRC-028_FRM04

RISK REGISTER DETAILS FORM

Contract Number:		Originator:	
Project/Asset Name:		Date:	

Risk Identification											Risk Analysis				Risk Management					
Risk ID	Raised By	Date Raised	Threat or Opportunity	Risk Category	Risk Cause	Risk Description	Risk Type	Status	Reason for Closing	Date Closed	Likelihood	Impact	Risk Score	Risk Rating	Risk Response Type	Risk Response Description	Risk Response Action Update	Risk Response Party	Risk Response Review Date	Last Updated

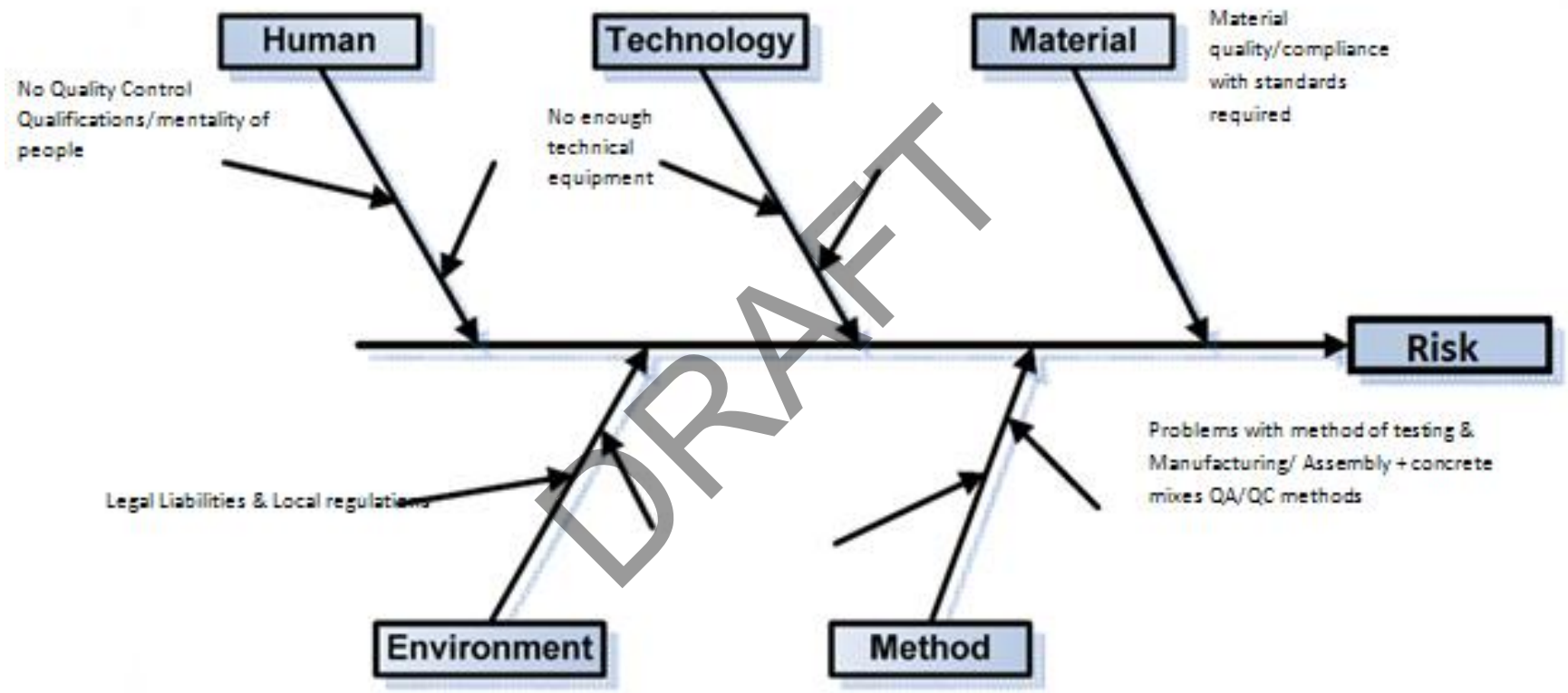
NEOM نيوم

Risk Identification											Risk Analysis				Risk Management					
Risk ID	Raised By	Date Raised	Threat or Opportunity	Risk Category	Risk Cause	Risk Description	Risk Type	Status	Reason for Closing	Date Closed	Likelihood	Impact	Risk Score	Risk Rating	Risk Response Type	Risk Response Description	Risk Response Action Update	Risk Response Party	Risk Response Review Date	Last Updated

Filled by:

Submitted to:

ISHIKAWA Template



		Risk Register Template
Source		The group that worked on the risk template.
ID		Risk ID related to the risk template.
Risk Name		Name of the Risk specified.
Category (from RBS)		Related risk category from the risk breakdown structure.
ISHIKAWA/Decision Tree Reference #		Ishikawa and Decision tree drawings related to the risk specified.
WBS / Activity / Code		Taken from the project program.
Pre-Mitigation Assessment	Probability	
	Impact Cost	
	Impact Time	
	Imapct Scope	
	Impact Quality	
	Score	Score = Probability x Impact
	Rank	According to Score.
Quantitative	Probability	IF Probability=5, 0.8, IF Probability=4, 0.4, IF Probability=3, 0.2, IF Probability=2, 0.1, IF Probability=1, 0.05
	Cost Impact	Taken from the project program.
	Time Impact	Note: Did not conduct Time delay/criticality analysis to calculate Quantitative time impact on the project.
Risk Value		Risk Value= (Time impact + Cost impact) x Probability
Mitigation Cost		From Ishikawa, Decision tree, and suggested solutions.
Residual Risk		
Secondary Risk		
Revised Risk Value		If Mitigation Cost+Secondary Risk=0 Then Revised Risk Value=Contingency Reserve+Fallback Plan Allocation.
Contingency Reserve		Contingency Reserve= Residual Risk+Secondary Risk.
Fallback Plan Allocation		Applied in Severe cases.

Appendix C

Project Risk Management Monthly Report Form

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NEOM-NEN-PRC-028_FRM05

PROJECT RISK MANAGEMENT MONTHLY REPORT FORM

Contract Number:		Originator:	
Project/Asset Name:		Date:	
Filled by:		Submitted to:	

Project Name		Supervision Consultant	
Portfolio		Contractor	
Current Phase		Starting Date	
PM		Completion date	
NEOM Rep		Est. Completion Date	
Design Consultant		Final Aproved Budget	

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Risk Overall Status

Total No. of Open Risks	
Average Risk Rating[1]	
Risk Trend[1]	

Project Description

Risk Overview

Notes

[1]Provides a snapshot of the number of open risks and their average rating. The risk score color codes are dependent on the impact and likelihood score derived from the matrix provided here. The arrows reflect the change in risk rating month over month (↑) risk increased , (↓)risk decreased, (→)no change.

	Impact (cost/schedule)				
Likelihood	<1%	1% to 2.5%	2.5% to 5%	5% to 10%	>10%
>75%	-5	-10	-15	-22	-25
>50% ≤75%	-4	-9	-14	-21	-24
>25% ≤50%	-3	-8	-13	-18	-23
>5% ≤25%	-2	-7	-12	-17	-20
≤5%	-1	-6	-11	-16	-19

This table is indicative and depends on project criteria.

Top 10 Risks

Risk Cause	Risk Description	Risk Category	Risk Response Description	Risk Response Action Update	Response Party	Action Owner	Risk Rating

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NEOM-NEN-PRC-028_FRM06

RISK SUMMARY FORM

Contract Number:		Originator:	
Project/Asset Name:		Date:	
Filled by:		Submitted to:	

Current State	
Status	
Project Name	

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Risk Category	Threat Rating				
	Negligible Threat	Significant Threat	Severe Threat	Critical Threat	Grand Total
Authorities & Regulations					
Construction					
Design					
Commissioning & Handover					
Procurement					
Project Cost					
Resources					
Scope & objectives					
Site Conditions					
Total					